# Operator's Manual

# ASCO® 300 Series Power Control System 336 /337 Generator Paralleling System

**⚠ DANGER**

DANGER is used in this manual to warn of a hazard situation which, if not avoided, will result in death or serious injury.

**⚠ WARNING**

WARNING is used in this manual to warn of a hazardous situation which, if not avoided, could result death or serious injury.

**⚠ CAUTION**

CAUTION is used in this manual to warn of a hazardous situation which, if not avoided, could result in minor or moderate injury.

Refer to the outline and wiring drawings provided with the 336 / 337 for all installation and connection details and accessories.

Refer to the Controller User's Guide for status display messages, time delays, pickup and dropout settings, and adjustments.

## Rating Label

Each 336/337 PCS contains a rating label to define the loads and fault circuit withstand/closing ratings. Refer to the label on the transfer switch for specific values.

In a non-redundant system, that is, the load current is more than one generator's full load current and the generators are being paralleled to provide more power to the load, the CTTS current rating must be equal to or greater than the sum of the two generator's full load amps.

If the application is a redundant system, that is, the load current is equal to or less than the full load amps of one generator and the generators are being paralleled for redundancy, the 336 or 337 rating must be equal to or greater than the full load current of the biggest generator. In addition, the output of the CTTS unit must be protected by an over current device, like a circuit breaker, equal to or less than the CTTS rating label.

**⚠ WARNING**

Do not exceed the values on the rating label. Exceeding the rating can cause personal injury or serious equipment damage.

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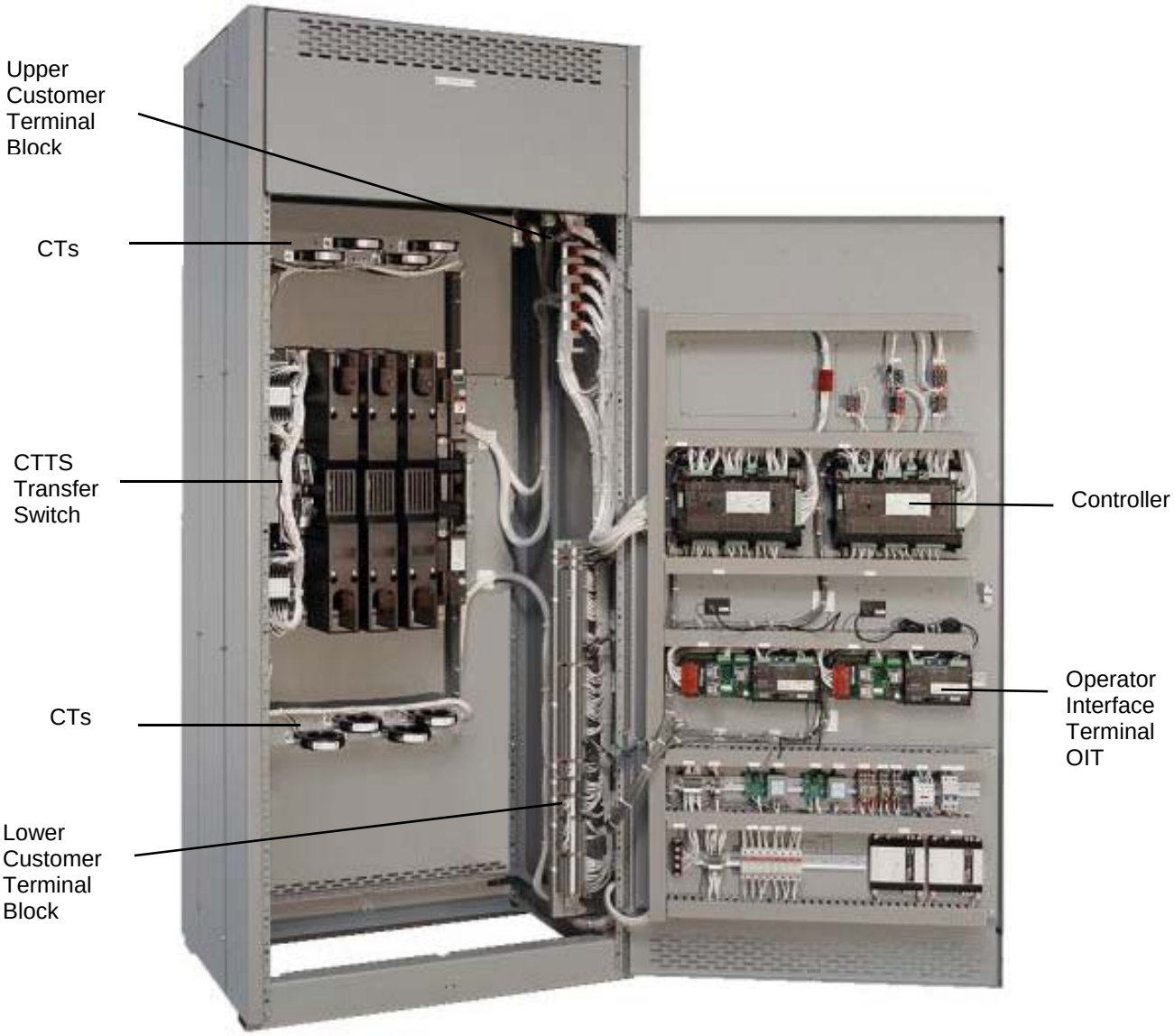
## 300 Series PCS Family of Products

The ASCO 300 Series Power Control System (PCS) is a family of affordable and feature-rich products for paralleling generators, controlling loads, and connecting generators to the utility power system or grid. Transfer switch based or circuit breaker based power switching options are available to meet the requirements of all applications. The PCS 300 Series control system is an integrated platform that provides sequencing, synchronizing, generator load sharing, protective functions, power management, and many other industry-leading features, all while minimizing costs.

## 336 / 337 PCS

The ASCO 336 / 337 PCS utilize the ASCO Power Technologies industry-leading and time-proven Closed Transition Transfer Switch (CTTS) mechanism to parallel two generators per CTTS unit. The 336 manages the first two generators of any system. The 337 can be added to manage the third and fourth generators of a four generator system. Due to the fault currents available, usually four generators is the limit of a 336/337 PCS system. There are alternatives within the 300 Series for paralleling more generators: contact ASCO Power Technologies for more information.

A 337 may be added later as long as the electrical power infrastructure is compatible. Options must be the same in a 336 and 337 for proper operation.




Typical 336 Series PCS H-design 800-1200 ampere

### Automatic Control System

The 336 / 337 is an automatic control system that may start and/or stop generators and operate the transfer switch at any time to maintain power to the load.

**⚠ WARNING**

Proper precautions must be taken, including tag out / lock out procedures, to ensure personnel safety.

## Installation

The system is factory wired and tested. Installation requires mounting, connecting service cables, and connecting generator control and generator circuit breaker control circuits.

***NOTICE***

System installation and startup by ASCO Power Technologies is recommended.

An experienced licensed electrician must install the system.

### Supporting Foundation

The supporting foundation for the enclosure must be level and straight. Refer to the applicable enclosure outline drawing included with the system for all mounting details including door opening space.

If bottom cable entry is used, the foundation must be prepared so that the conduit stubs are located correctly. Refer to the enclosure outline drawing for specified area and location. Provide cable bending space and 1 inch minimum clearance to live metal parts. When a concrete floor is poured, use interlocking conduit spacer caps or a wood or metal template to maintain proper conduit alignment.

### Mounting

Refer to the outline and mounting diagram and mount the transfer switch according to details and instructions shown on the diagram. Mount it vertically to a rigid supporting structure. Level all mounting points by using flat washers behind the holes to avoid distortion of the transfer switch.

***NOTICE***

Protect the transfer switch from construction grit and metal chips to prevent malfunction or shortened life of the transfer switch.

### Line Connections

Refer to the wiring diagram provided with the transfer switch. All wiring must be made in accordance with the National Electrical Code and local codes.

**⚠ DANGER**

De-energize the conductors before making any line or auxiliary circuit connections. Be sure that the Generator 1 and Generator 2 line connections are in proper phase rotation. Place the engine generator starting controls in the OFF position. Make sure engine generators are not in operation.

### Testing Power Conductors

Do not connect the power conductors to the transfer switch until they are tested. Installing power cables in conduit, cable troughs, and ceiling-suspended hangers often requires considerable force. The pulling of cables can damage insulation and stretch or break the conductor's strands. For this reason, after the cables are pulled into position, and before they are connected, they should be tested to verify that they are not defective or have been damaged during installation.

### Connecting Power Cables

After the power cables have been tested, connect them to the appropriate terminal lugs (if provided) on the transfer switch as shown on the wiring diagram provided with the transfer switch. Make sure that the lugs are suitable for use with the cables being installed. Be careful when stripping insulation from the cables; avoid nicking or ringing the conductor. Remove surface oxides from cables by cleaning with a wire brush. When aluminum cable is used, apply joint compound to conductors. Tighten cable lugs to the torque specified on rating label.

## Generator Circuit Breaker Control Circuits

The generator circuit breaker control connections are located on customer terminal block. Connect signal wires to appropriate terminals as specified on the wiring diagram.

### Generator circuit breaker

The generator circuit breaker provides the overcurrent (short circuit) protection for the system and functions as a back-up to protect/isolate the system upon a fault during the loss of AC control power. It does not matter if the generator circuit breaker is manually operated close or electrically operated close, but it must have a shunt trip and auxiliary contacts.

The control system has a dry contact (CTBx:19 to CTBx: 20, rated at 8A, 30VDC or 8A, 250VAC, tripping duty) available for shunt tripping the generator circuit breaker. This contact must be connected during installation.

CTBx: x is the generator number.
Gen1 is CTB1, Gen 2 is CTB2.

There is an option to have wire break monitoring of this shunt trip coil. This requires (1) the shunt trip coil to be 24Vdc, (2) supplied from the same source as the control system (normally the generator batteries), and (3) not connected to any other tripping circuit devices. This wire break system functions by passing a small amount of current thru the breaker trip coil; if this current gets too low, a wire break is assumed. If any other devices are connected, for example indicating lights or other trip devices, the wire break function may not work. The maximum resistance of the trip coil circuit that this function will work is 100 ohms. That is, if the circuit resistance exceeds 100 ohms, this function will alarm a wire break. Default from the factory is this feature is not enabled; ASI may enable it during startup.

If the generator circuit breaker is open the control system needs to know that this gen-set is not available. This requires a normally open *dry* contact (52/a: closed when the circuit breaker main contacts are closed) to be wired to the control system, CTBx:9 to CTBx:10. There should be no other connections to this circuit. This is a contact input, *wetted* by internal 24VDC (interrogation voltage) from the controller power. If the generator circuit breaker is open, this generator is not available and the Power Management option will not include this generator in the gen shed/gen add program.

If the generator circuit breaker opens for any reason, the CTTS will open when AC control power is available. The control system will alarm and not be available until the generator circuit breaker is closed again and the alarm is reset. If this is the only generator running and the circuit breaker trips, the CTTS may be closed. See AC Control Power Circuit description.

## Grounding different generator DC controls

Generators paralleled by the 336/337 system do not have to be the same size or even manufacturer. However, different DC grounding schemes may not be compatible with each other. Optional DC to DC isolators can be added to the DC Control Power circuit to prevent circulating currents and/or unintentional grounds.

***NOTICE***

Optional DC to DC isolators are recommended for all applications.

If all the generators utilize the same type of grounding – for example, the negative pole of the batteries are all solidly grounded – and the grounding system installation is good, this may not be necessary. But, by example, if one generator uses a solidly grounded DC scheme and the second generator uses a floating DC system or the integrity of the DC ground connection(s) is/are not known or reliable, then this option is required. If the all generators use the same grounding scheme for the DC control power and the installation is perfect, this optional feature may not be needed.

## Changing settings

Most settings require a password to change. There are 3 levels of passwords: Customer, Service, and Master. The Customer password is 1111 and will allow access to the nominal settings like voltage, frequency, generator KW, etc. The Service level password is known to authorized ASI service representatives and is required for startup. The Master level password is reserved for factory use.

While it is possible to program the controller from the keypad, most users will find it more efficient to use a laptop computer, an A/B USB cable (see Figure 1), and the free Utility Software available from the 336/337 website. In the Designer's Reference Handbook are directions for installing the software, connecting the controller to the laptop, and making changes to the settings.

Figure 1. A/B USB cable for programming controller.

# Functional Test

The functional test consists of three checks: manual operation, voltage checks, and electrical operation.

***NOTICE***

Do these checks in the order presented to avoid damaging the transfer switch.

## 1 – Manual Operation

A maintenance handle is provided on the transfer switch for maintenance purposes only. Manual operation of the transfer switch should be checked before it is energized (before it is operated electrically). Note the contact position indicators.

**⚠ WARNING**

Do not manually operate the transfer switch until all power sources are disconnected: open both generator circuit breakers and all load circuit breakers.

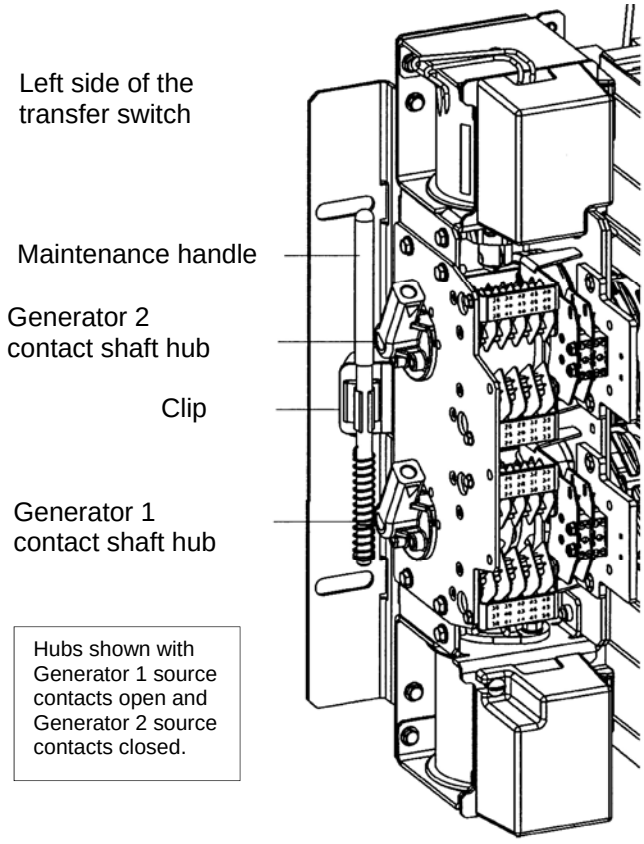

Left side of the transfer switch
Maintenance handle
Generator 2 contact shaft hub
Clip
Generator 1 contact shaft hub
Hubs shown with Generator 1 source contacts open and Generator 2 source contacts closed.

Figure 2. J-design transfer switch maintenance handle.

1. After deenergizing both power sources, open the enclosure door. Locate and remove the maintenance handle. Select either H-design or G-design. See Figures 2 and 3.

   J & H-design see Figures 2 & 3
   The maintenance handle is stored in clips on the left side of the transfer.

   G-design see Figure 4
   The maintenance handle, hub, and pin are stored on the center frame of the transfer.

2. Install the handle into the hole in the molded hub. Move the handle up or down as shown to manually operate the transfer switch to close and reopen the contacts. It should operate smoothly without any binding. If it does not, check for shipping damage or construction debris.

   J & H-design see Figures 2 & 3
   The transfer switch has two contact shaft hubs Install the maintenance handle into the hole in the molded hub. The upper hub operates the Generator 2 contacts. The lower hub operates the Generator 1 contacts.

   G-design see Figure 4
   Install the hub (with pin) onto the shaft. Insert the maintenance handle into the side hole in the hub. Push in the shaft to operate the Generator 1 contacts. Pull out the shaft to operate the Generator 2 contacts.

3. After checking manual operation, return all transfer switch contacts to the open position. Generator 1 and Generator 2 contacts must be open. Check contact position indicators.

4. Remove the maintenance handle and store it on the transfer switch in the place provided.

   J & H-design see Figures 2 & 3
   Store the maintenance handle in the clips on the left side of the transfer.

   G-design see Figure 4
   Store the maintenance handle, hub, and pin on the center frame of the transfer.

Note: If Generator 1 and Generator 2 connections are reversed this operation is also reversed.

**⚠ WARNING**

Verify that the maintenance handle has been removed and stored properly before electrically operating the transfer switch.

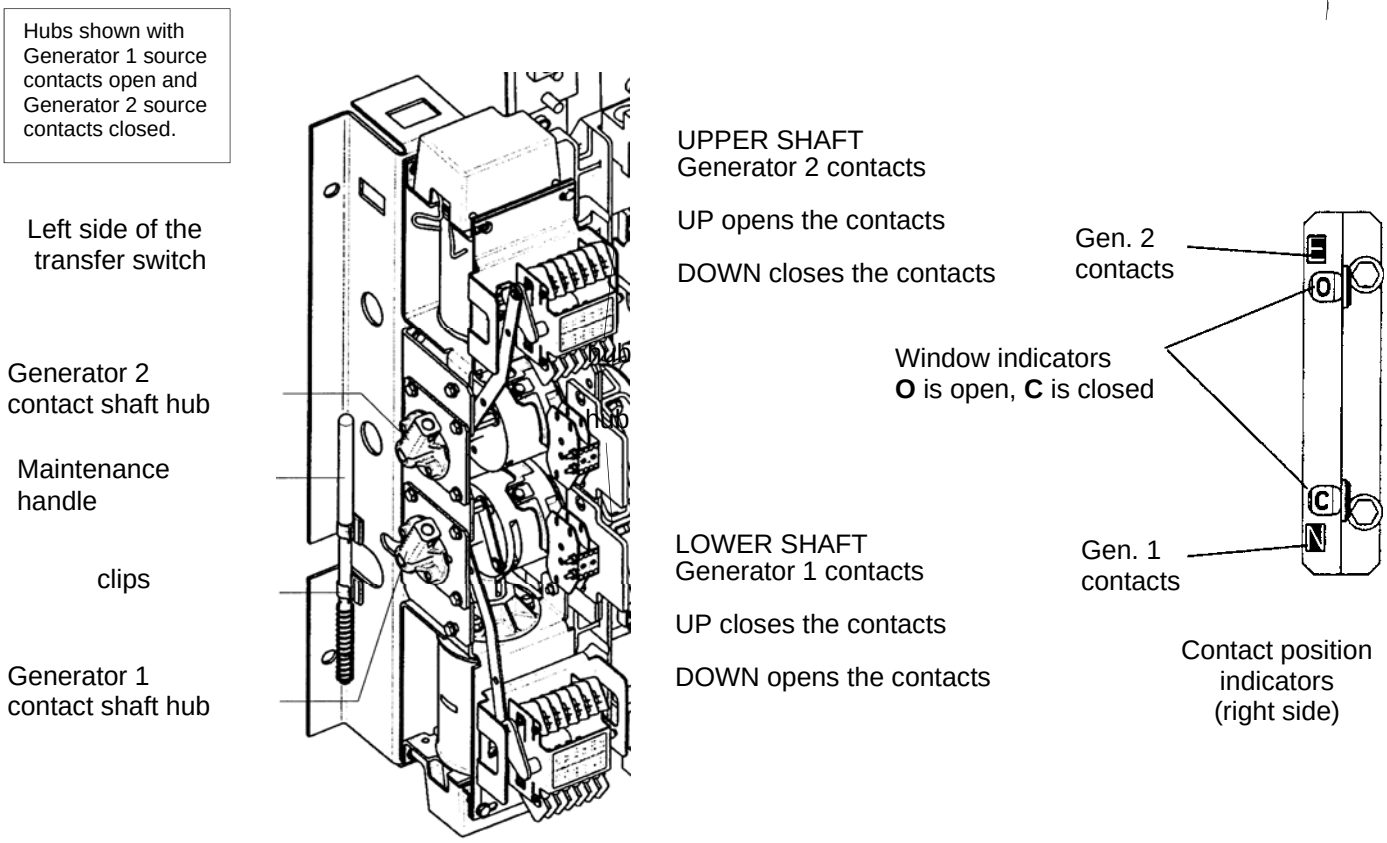

Hubs shown with Generator 1 source contacts open and Generator 2 source contacts closed.
Left side of the transfer switch
Generator 2 contact shaft hub
Maintenance handle
clips
Generator 1 contact shaft hub
UPPER SHAFT
Generator 2 contacts
UP opens the contacts
DOWN closes the contacts
LOWER SHAFT
Generator 1 contacts
UP closes the contacts
DOWN opens the contacts
Gen. 2 contacts
Window indicators
O is open, C is closed
Gen. 1 contacts
Contact position indicators (right side)

Figure 3. H-design Transfer Switch Maintenance Handle Operation.

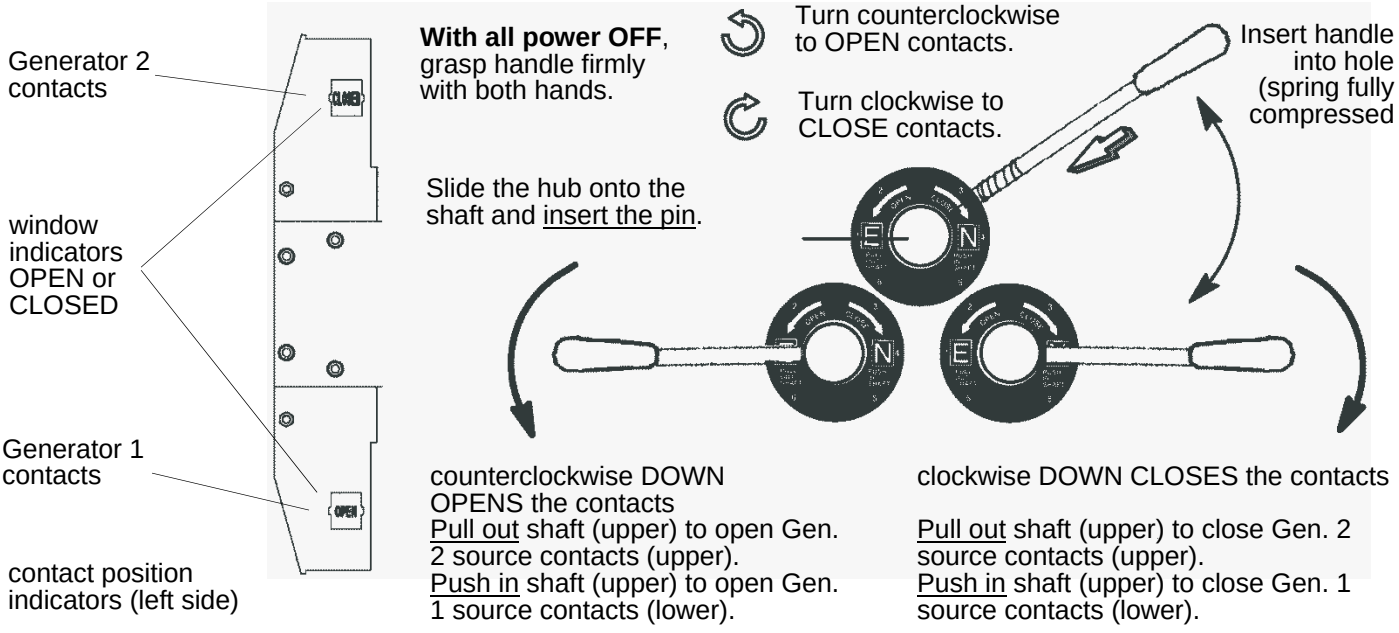

Generator 2 contacts
window indicators OPEN or CLOSED
Generator 1 contacts
contact position indicators (left side)
With all power OFF, grasp handle firmly with both hands.
Turn counterclockwise to OPEN contacts.
Turn clockwise to CLOSE contacts.
Insert handle into hole (spring fully compressed
Slide the hub onto the shaft and insert the pin.
counterclockwise DOWN OPENS the contacts
Pull out shaft (upper) to open Gen. 2 source contacts (upper).
Push in shaft (upper) to open Gen. 1 source contacts (lower).
clockwise DOWN CLOSES the contacts
Pull out shaft (upper) to close Gen. 2 source contacts (upper).
Push in shaft (upper) to close Gen. 1 source contacts (lower).

Figure 4. G-design Transfer Switch Maintenance Handle Operation.

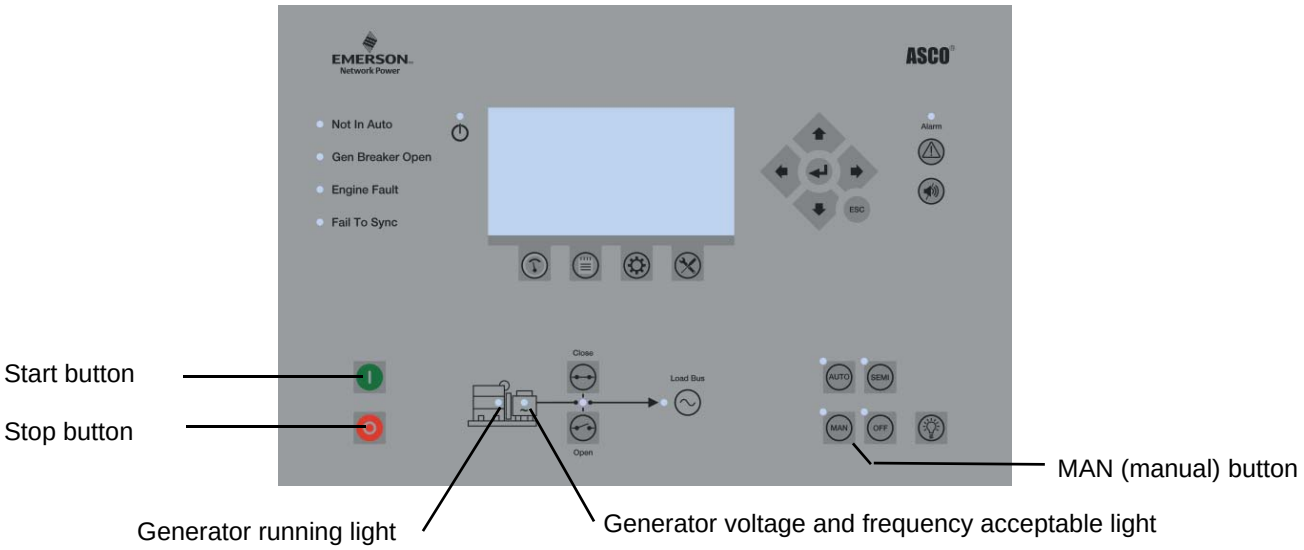



Figure 5. Buttons and indicator lights on generator controller for voltage checks.

## 2 – Voltage Checks

First check the nameplate on the PCS 336 System and the transfer switch; the rated voltage must be the same as Generator 1 & 2 rated output voltages. Be sure that these controls are the following positions before starting:

- **Master Control Switch** in *Off* position
- **Power Management Selector** switch in *Off* position
- Generator 1 Circuit Breaker closed (on)
- Generator 2 Circuit Breaker closed (on)
- Both Generators off, not running
- Transfer switch contacts open (both upper & lower)

**⚠ DANGER**

**Use extreme caution when using a meter to measure voltages in the following steps. Do not touch power terminals; shock, burns, or death could result!**

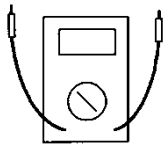
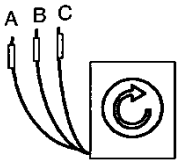
**⚠ DANGER**

**Multiple sources of potentially lethal voltages may be present in any one enclosure!**

Perform steps 1 through 6 at the right. Observe the indicator lights. See Figure 5.

* If necessary, adjust the voltage regulator on the generator according to the manufacturer's recommendations. The PCS 336 System will respond only to the rated voltage specified on the transfer switch nameplate.

Also see the controller manual for settings.

| | | |
|---|---|---|
| 1 | Press the **MAN** (manual) button on <u>both</u> controllers. | |
| 2 | Press the start button for Generator 1. The generator running light and generator acceptable light should both come on. | Gen 1 Acceptable |
| 3 | Press the start button for Generator 2. The Generator 2 acceptable light should come on. | Gen 2 Acceptable |
| 4 | Use an accurate voltmeter to check phase to phase and phase to neutral voltages present at the transfer switch Generator 1 & 2 terminals.* |  |
| 5 | Use a phase rotation meter to check phase rotation of Generator 1 & 2 at the transfer switch. They must be the <u>same</u>. |   |
| 6 | Shut down Generator 1 & 2 by pressing <u>both</u> stop buttons. The Generator 1 & 2 accepted lights should go off. Then put starting controls (on generator sets) in the automatic position. | Gen 1 and Gen 2 |

Continue to **3 – Electrical Operation** on the next page.

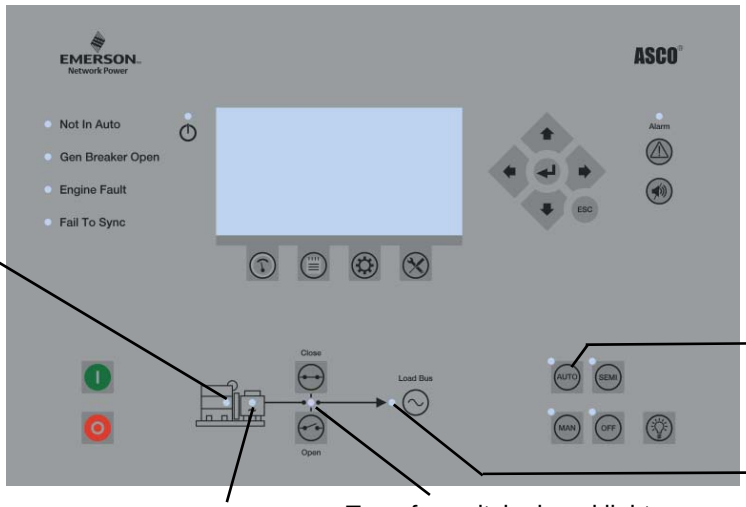



Figure 6. Button and indicator lights on generator controller for electrical operation.

## 3 – Electrical Operation

This procedure will check the electrical operation of the 336 system. The generators will be started and connected to the load bus. Be sure that these controls are the following positions before starting:

- **Master Control Switch** in *Off* position
- **Power Management Selector** switch in *Off* position
- Generator 1 Circuit Breaker closed (on)
- Generator 2 Circuit Breaker closed (on)
- Both Generators off, not running
- Generator starting controls in Automatic position
- Transfer switch contacts open (both upper & lower)

**⚠ WARNING**

Close the system enclosure door and tighten the screws (if provided) before you test electrical operation.

Perform steps 1 through 5 at the right. Observe the status lights. See Figure 6.

**NOTE:**
See controller manual settings in the controller.

***NOTICE***

The speed, KW, voltage, & KVAR regulators should be properly tuned during start up for stable system operation by a qualified ASI service technician.

This completes the functional test of the transfer switch. Leave the engine-generator starting controls in the automatic position.

| | | |
|---|---|---|
| 1 | Press the **AUTO** (automatic) button on <u>both</u> controllers. | |
| 2 | Turn the **Master Control Switch** to the *On* position. | |
| 3 | Both generators should start. Both generator running lights and both generator acceptable lights should come on. The transfer switch should operate to close one set of contacts. The close light should come on, and the power on the load bus light should come on. The connection of the second generator to the load bus occurs when the generators are in synchronism. | |
| 4 | Turn the **Master Control Switch** to the *Off* position. | |
| 5 | The transfer switch contacts should operate again to open both sets of contacts. The close lights should go off. The power on the load bus light should also go off. After a cool-down period, both generators should shut down. | |

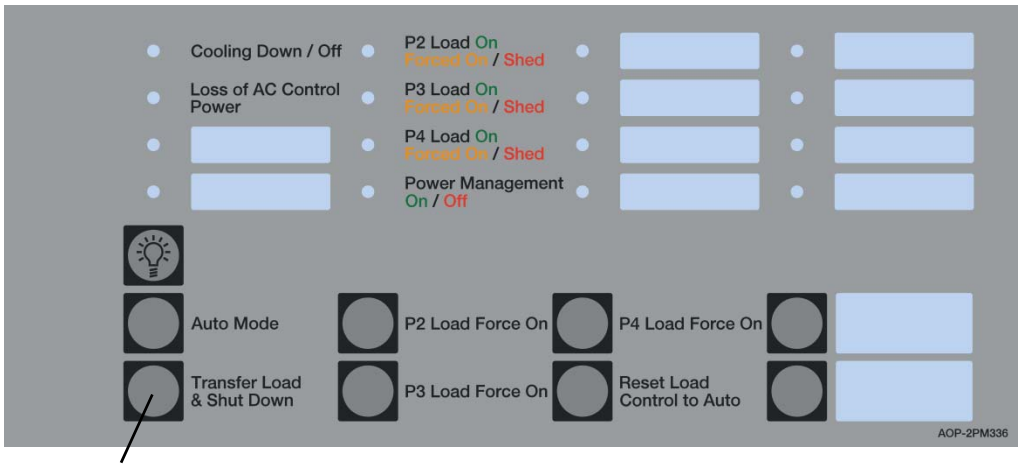



Figure 7. Operator Interface Terminal (OIT) with Power Management option.

## Operational Testing

Load testing on optional power management systems may be done by turning off power management. That will start all available generators that were shed by the generator shed function. Individual generators may then be taken off line by pressing the **Transfer Load & Shut Down** button on OIT.

The **Transfer Load & Shut Down** button may not shut off a generator if doing so might overload the remaining generator(s) or additional generator(s) are not available to take over the load. To manually operate the system, the Semi-Automatic (Semi) mode may be used. Semi-Automatic is also known as assisted automatic mode. Here are two examples:

1. On the generator that is to be started to accept the load:
   a. Press the **Semi** button.
   b. Press the green **1** button.
      If available, the generator will start.
   c. Press the **Close** button.
      The generator will synchronize and close to the bus.
2. On the generator that is to be shut down
   a. Press the **Semi** button.
   b. Press the **Off/Cooldown** button. (Off/Cooldown may be cancelled at any time by pressing the **Auto** button.)

Pressing Auto on the generator that has been shut down may or may not return it to service depending upon the generator shed/add status and the Run Time Management status.

In a system without power management, all generators will be running when the **Master Control Switch** is in the *On* position or in *Auto* with the customer remote control contact closed.

No load testing may be done by selecting MAN mode from the front panel, then press the green **1** button to start the generator. When test is complete, press the red **0** button to stop the generator then the **Auto** button to return the generator to automatic mode.

## Mode Selection

This system is designed to stay in Auto mode all the time. If the controller is not in Auto or will not switch to Auto mode, check the alarm log and reset any active alarms. One possible cause is the status of the generator circuit breaker. If it trips, the system will fault and go to manual mode.

Manual Mode may be used to run the generator for no load test, see Operational Testing.

Semi automatic mode is also known as assisted automatic mode. It is not often used on this system. For more details, see the detailed documentation available on the website.

Off mode turns off the control system and takes the generator out of system control. The Transfer Load & Shut Down command turns off a running generator. It is necessary to press Auto mode, either on the OIT or the controller itself to return the system to automatic mode.

Note: The green **1** and red **0** buttons are disabled in Auto mode. The **Transfer Load & Shut Down** button on the OIT will shut down a running generator via the normal shut down and cool down processes. An **Emergency Stop** will immediately trip the CTTS contacts and immediately shutdown a generator. **Emergency Stop** should not be used on a hot, running, generator unless necessary. Engines may be damaged if they are not allowed to follow the normal cool down process.

## Load Bus Ready for First Generator

CTBx: 11,12, First CTTS Close Enable

If it is possible that the connected load would exceed the capacity of first gen, it is necessary to open the load ATSs or CBs before the first gen could come on the bus.

Once any generator starts, generator AC power is available from the AC Control Power Selector Circuit for this purpose, but the 336 or 337 CTTS main power contacts may not be closed until this load is off the load bus, else it will trip immediately on overload. Interlock contacts will need to be connected from the load device(s) to all the controllers. This is a contact input, *wetted* by internal 24VDC (interrogation voltage) from the controller power. Conducting means the load is below the capacity of that generator and it is ok to bring that generator on the bus. All generators will start, but none will energize the bus if this contact is open on all of them. Do not parallel contact inputs from different controllers together: the system could be damaged. Separate contacts must be wired to each controller. Separate contacts are used because it is possible to have different size generators. Once the first generator is on the load bus, this contact is ignored and the other generators parallel normally to share the load.

## Neutral or Ground current CT

If the power system is 3 phase 4 wire, the fourth CT input is designed to measure the neutral current. If the power system 3 phase 3 wire, this input may be used to measure ground current. It is critical the power system grounding is connected correctly for this current, neutral or ground, to be measured properly. See drawings for details.

## AC Control Power Selector Circuit and the Loss of AC Control Power

The generated voltage is available from the AC Control Power Selector Circuit (fused at 20A) before the primary power contacts close. This AC power could be used to operate load ATSs or other system requirements. It is also used to open any CTTS contacts left closed by unintentional or emergency operations.

Loss of AC Control Power is not necessarily a fatal error: the control system monitors AC Control Power and can take other actions if a trip is needed. See Protective Relaying Functions.

The generator circuit breakers are normally closed so AC Control Power is available from the line (generator) side of both halves of the CTTS before the main power contacts close. The AC Control Power Selector Circuit provides AC power from either of the 2 generators (any one of the gens in a 4 gen system). The voltage of this AC Control Power Selector Circuit will be the system phase-to-phase voltage. If several load ATSs are to be operated, it might be necessary to stagger their operation to prevent blowing the control power fuse.

In a 336, one Source Selector Relay (SSR1) will switch AC control power from either Gen1 OR Gen2. In a 4 gen system, SSR1 in the 337 will switch between Gen3 and Gen4. The output of the 2 SSR relays, 1 in the 336 and the other in the 337, will feed SSR2 in the 337. In Boolean logic terms, SSR2 switches [(Gen1 OR Gen2) OR (Gen3 OR Gen4)]. Thus if any generator is running, AC Control Power will be available to all.

**⚠ WARNING**

There could be several different sources of AC Control Power in the system. If any generator is running, there will be potentially lethal voltages in every section.

Loss of AC will be detected by the controller, alarmed, and indicated on the controller. Each controller will detect its own generator AC power and pass this information to the other controllers via internal communications link, thus if any gen is on, all controllers will know the status of the AC Control Power.

Figure 8. Emergency Stop buttons for generators.

# Features and Options

The standard 336/337 system is automated and simple to operate. When the **Master Control Switch** is turned to *On* or a remote control contact closes while in *Auto* mode, all available generators start and synchronize to the load bus.

## Generator Emergency Stop

Direct wired system and individual generator **Emergency Stop** buttons are standard. These are emergency only controls. Under normal operation, generators should go through a cool-down process before turning off.

## Power Management Selector

The **Power Manager Selector** controls the optional Power Management system to provide four additional features:

- Generator Management or *Gen shed / Gen add*
- Load Management or *Load shed / Load add*
- Run Time Management or Run Time Equalization
- Start Next Gen on Alarm

**Generator Management**, or *Gen shed / Gen add* will add and remove generators to the bus as needed to maintain a certain percentage of spinning reserve KW. Spinning reserve is the sum of the KW of the available generators minus KW consumed. Numbers in brackets [8013, 70%] below are the memory locations of that setting and typical values. These are the factory default settings and should work for most installations, but they can be changed by trained personnel with the necessary password(s).

These values are examples and should be set to the correct system-specific values during startup.

The Generator Management sequence is:

1) All generators will start or are running before Power Management is switched on.
2) All loads will be allowed to close onto the load bus if Available Power (see load control) settings are met.
3) If the remaining generators will stay below the Load Dependent Stop Setpoint [8013, 70%] when the next generator is off line, the system will, after a programmable time delay [8014, 30 sec], deload and shut down the next generator.
4) If the spinning reserve falls below the Load Dependent Start setpoint [8003, 70%], the next lowest generator will be added to the bus.

All generators share the percent of load equally, thus all controllers see the same value. Generator management is based on this percentage of load.

***NOTICE***

This feature is a Power Management function. Turning off Power Management will remove the shed signal and start all available generators.

**Load Management** or *Load Shed / Load Add* will work in cooperation with Generator Management to keep the highest priority loads energized. In the event of a generator(s) becoming overloaded, Generator Management will add the next available generator to the bus automatically. If this is not possible due to generator failure or until the next generator is available, Load Management will keep the most critical loads energized by removing non-essential loads. Four levels of load shed/load add are available with the highest level (P1) never being shed.

This system is designed to interface with ATSs with Accessory 30A, thus the logic is setup to de-energize relays PR2, PR3, and PR4 to open contacts to request the downstream ATS's shed load (or stay on Normal). Conversely, PR2, PR3 and PR4 relays will be energized to allow the downstream ATSs to close. (PR = Priority control Relay) Each generator has its own PR relays, thus the Load Management system will function with any number of generators operating.

There are three Available Power setpoints, one for each Priority Load. They are factory set to be the same value, 105%. Please note that P1 loads are never shed, so this discussion only concerns loads P2, P3, and P4 controlled by PR2, PR3, and PR4 respectively. All generators share load in terms of percent of KW, so if one generator is at 105% load, all generators will be at 105% load.

These values are examples and should be set to the correct system-specific values during startup.

### Load Shed

1) If the load on any one generator exceeds [1880, 105%] for [1882, 1 sec], P4 loads will shed. (drop out PR4)
2) If the load on any one generator exceeds [1870, 105%] for [1872, 5 sec], P3 load will be shed. (drop out PR3)
3) If the load on any one generator exceeds [1860, 105%] for [1882, 10 sec], P2 load will be shed. (drop out PR2)
4) If the load on any one generator exceeds [1490, 110%] for [1492, 0.1 sec] OR generator Hz drops below [1260, 58.5 Hz] for [1262, 1 sec], ALL lower priority loads (P2, P3, and P4) are shed.
5) If Power Management is turned on before the system is given a start command, the Load Management becomes active when the first generator energizes the bus. As spinning reserve becomes available, the contacts will close and allow the downstream ATSs to close onto the load bus.

***NOTICE***

This is a Power Management function, thus turning off Power Management will return all loads to service, possibly resulting in a system overload.

### Load Add

The controller calculates the spinning reserve KW, also called Available Power KW. Note that while Load Shed is done by the percent of load of a/any generator, Load Add is done by KW. Thus this function will work with any number of generators running. There are no typical values for Available Power set points: these must be set during startup. Available Power 1 should be the expected KW of the P2 loads, Available Power 2 the expected KW of P3 loads, and Available Power 3 the expected KW of the P4 loads.

1) If the spinning reserve is greater than Available Power 1 KW [8220] for [8222, 1 sec], PR2 will pick up and allow P2 loads on the bus.
2) If the spinning reserve is greater than Available Power 2 KW [8230] for [8232, 5 sec], PR3 will pick up and allow P3 loads on the bus.
3) If the spinning reserve is greater than Available Power 3 KW [8240] for [8242, 10 sec], PR4 will pick up and allow P4 loads on the bus.

It is possible to set Available Power more than one generator can handle, thus a load may not be added until more than one generator is running. Generators are added by Gen Add function, described above.

It is important to note that the controller does not actually control the load ATS, rather it signals the ATS to allow the ATS to decide if it will return the load to the bus. It is possible there is a control function or problem in the ATS that will not allow it to switch.

Loads always shed and add in order: PR4 always sheds first and adds last. PR2 always sheds last and adds first. It is not possible to skip a priority but loads may be manually forced on by pressing P2, P3, or P4 Force On buttons.

Note: Be careful manually adding loads that were shed. If too much load is manually forced on, it is possible to overload the system and the protective relaying function may trip the generator(s) or if any one generator exceeds [1490, 115%] for [1492, 0.1 sec] or the load bus frequency drops below [1260, 97.5%] for [1262, 1 sec], ALL P2-P4 loads will be shed.

**Reset Load Control to Auto** button returns to automatic load control, possibly shedding some loads. There is no 'force off' function; normally this can often be done at the individual ATS.

***NOTICE***

This is a Power Management function, thus turning off Power Management will return all loads to service, possibly resulting in a system overload.

**Run Time Management** or **Run Time Equalization**

Run Time Management (RTM) function may be set to keep the generators roughly equal in running hours. This could result in all generators requiring maintenance at the same time, so RTM may be also be set to run a generator(s) more hours so maintenance is staggered. When the run hours timer setting [8111, 24 hours] expires, the generator with the lowest running hours will be started, synchronized, soft loaded, and the one with the highest hours will be shut down. Setting [8111] to 24 hours will equalize running hours every day. Setting it to 30 days will run one generator for 30 days, then run the next one for 30 days, intentionally staggering the running hours.

**Start Next Gen On Alarm**

If Power Management is On and one or more generators have been turned off by Generator Shed and a running generator goes into a warning or has a non-fatal alarm, the next available generator will start automatically, synchronize, and take on the load. Then the generator in alarm will shut down.

This feature requires either a hardwired contact input from the generator controls to CTBx:1 or a J1939 CANBUS connection to the ASCO Power Technologies control system on CTBx:37, 38, 39 and that correct programming be done during startup.

If a generator has a fault that results in an immediate shutdown, Power Management will start the next generator, switch the CTTS mechanisms as needed, and restore power to the load. See also AC Control Power Selector circuit.

If only 1 generator is running and the circuit breaker trips, it is could be due to a short circuit. If the Power Management Option is not installed, the system will be off and require operator intervention to return to service. If the Power Management option is installed, it is possible to either (1) start the next generator and energize the load bus or (2) lock out the system to prevent any generator from starting until the operator resets the system. This is selected during startup. The factory default is to lock out the system and wait for an operator reset. With the sudden loss of AC power the CTTS cannot switch the dead generator off the bus, so as soon as another generator starts, the closed CTTS on the genset with the tripped circuit breaker will open. If this is not possible, for example if only 1 gen is available and it is the one that tripped, obviously the system will not automatically return to service.

## Protective relay functions

Most protective functions will open the CTTS contacts and not the generator circuit breaker. There are two conditions that will trip the generator circuit breaker: (1) short circuit or fault currents detected by the circuit breakers' internal protective device and (2) if there is a loss of AC control power and a protective system fault resulting in a protective relaying trip, then the control system knows the CTTS will not operate and will trip the generator circuit breaker.

Just losing AC control power is not a fatal problem: the system will not shut down on loss of AC control power, it just shifts the protective trips (like ANSI 32R, 32RV, 27, 59, 81, etc.) to the generator circuit breaker.

Once the generator circuit breaker trips, however, operator intervention will be required to close manually operated circuit breakers in order to return the generator to service. For more details, see Generator Circuit Breaker section. Electrically closed circuit breakers may be controlled by the control system: contact factory for details.

Various electrical protective functions may be programmed in the controller. This section describes the function and the table at the end of this section lists the factory test and default values. Since every power system is unique, it is the customer's responsibility to set ALL protective functions to the correct value for a specific installation. Normally this requires a power system study, also the responsibility of others.

Note: Since the current transformers are in the CTTS, any faults between the generator and the CTTS must be detected and protected by the generator circuit breaker.

Over current, ANSI 50/51. Time over current and instantaneous over current protection may be set in the controller, but primary protection for these faults is the generator circuit breaker. The 50/51 elements in the controller are factory set to alarm only.

There is a 4th CT input that may be used for one of these functions:

1. Ground current detection and over current (50/51G) on 3P3W systems.
2. Neutral current detection and over current (50/51N) on 3P4W systems.
3. A single input differential (87G) protection. Requires additional, field installed, CTs. Contact factory for details.

Reverse power, 32R, may be set to protect both the generator and engine by detecting power flow into the generator. Forward power, 32F, may be set to protect against overload.

Reverse Vars / Field loss, ANSI 40/32RV. Var flow into the generator means the voltage of the generator is below the voltage of the system or other generators. Reverse var flow is also an indication of field loss that could indicate a problem with the generator's excitation system.

Over/under voltage, (59 and 27), Over/under frequency, (81O and 81U) are primarily set to protect the loads, but overvoltage may also damage the generator.

Negative sequence current (46) and voltage (47) may be used to detect an open phase on systems using fuses.

Other protective functions are available, see controller documentation.

| ANSI | Description | Trip/ Alarm | Factory Test Values / Default Settings |
|---|---|---|---|
| 27 | Under voltage | T/A | 90% for 10 sec |
| 59 | Over voltage | T/A | 110% for 10 sec |
| 32R | Reverse Power, power flow into Generator | T/A | 20% for 5 sec |
| 32RV | Reverse Vars, var flow into Generator, voltage below system volts | T/A | 50% for 2 sec |
| 32F | Forward Power, power out of Generator | T/A | 120% for 10 sec |
| 46 | Negative Sequence Current or phase loss detection | T/A | 20% for 1 sec |
| 47 | Negative Sequence Voltage or phase loss detection | T/A | 20% for 1 sec |
| 81U | Under Frequency | T/A | 90% for 10 sec |
| 81O | Over Frequency | T/A | 110% for 10 sec |
| 50 | Instantaneous Over current | A | 150% for 1 sec* |
| 51 | Time Over current | A | 125% for 5 sec* |

*These protective functions must be provided by generator circuit breaker. It is possible to program the controller to trip on these functions. ASCO CTTSs are rated to interrupt up to 6 times rated frame current, so it is quite possible that the CTTS could function as the over current trip device for the system protection. However the current is being sensed at the CTTS and the system relies upon the generator circuit breaker to protect the power system between the generator output terminals and the CTTS input.

# Testing & Service

## Transfer Test

Operate the transfer switch at least once a month by following the ***Electrical Operation*** procedure on page 8.

## Preventive Maintenance

Reasonable care in preventive maintenance will insure high reliability and long life for the transfer switch. An annual preventive maintenance program is recommended.

ASCO Services, Inc. (ASI) is ASCO Power Technologies' national service organization. ASI can be contacted at 1-800-800-2726 for information on preventive maintenance agreements.

## Replacement Parts

When ordering replacement parts provide the Serial No., Bill of Material No. (BOM), and Catalog No. from the transfer switch nameplate. In the US call 800-800-2726 (ASCO) or contact customercare@asco.com.

## Yearly Inspection

**⚠ DANGER**

Hazardous voltage capable of causing shock, burns, or death is used in this transfer switch. Deenergize both Normal & Emergency power sources before performing inspections!

**Clean the enclosure.** Deenergize all sources, then brush and vacuum away any excessive dust accumulation. Remove moisture with a clean cloth.

**Inspect the transfer switch contacts.** Deenergize all sources, then remove the transfer switch barriers and check the contact condition. Replace contacts when pitted or worn excessively. Reinstall the barriers carefully.

**Maintain transfer switch lubrication.** Under normal operating conditions no further lubricating is required. Renew factory lubrication if the transfer switch is subjected to severe dust, abnormal operating conditions, or if the TS coil is replaced. Order lubrication kit 920799 for J & H design and kit 920836 for G design.

**Check all cable connections & retighten them.** Torque to values shown on the transfer switch label.

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